Nonvolatile Resistive Switching in Layered InSe via Electrochemical Cation Diffusion

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Two dimensional (2D) materials are being increasingly investigated for their non-volatile switching properties due to their atomically thin sizing and scalability. Which, has the potential of addressing the issues faced by current CMOS technology. In our work, we investigate the interplay between electrochemically active silver (Ag) cations and layered indium selenide (InSe) for resistive switching mechanism. We further investigate the role and barrier faced by cations and anions in the aforementioned 2D switching medium. InSe a 2D metal monochalcogenide, is investigated to demonstrate a vertical non-volatile switching device (Figure 1a). As the development of vertical devices provides a pathway towards electronic chips with higher integration density. In this work, detailed microscopic characterization of the stack is done alongside density functional theory calculations. Which, indicates cationic filamentary-based non-volatile switching in our 2D InSe. The devices exhibit a bipolar switching mechanism with switching ratios of $\approx 10^3$ as shown in Figure 1b. Which, is governed by electrically driven Ag ions through the layered InSe. Moreover, the devices show a prolonged memory retention of $>10^5$ s. This work opens up new opportunities to understand and enhance resistive switching performances in ion driven 2D materials based non-volatile technology. Which, can be beneficial for next-generation information storage and brain inspired computation.

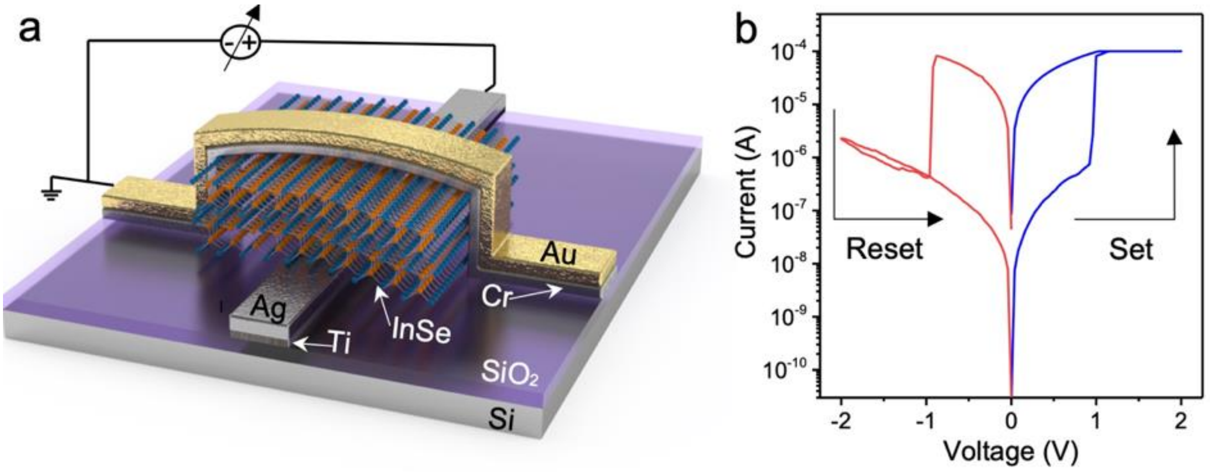

Figure 1: InSe memory cell and its electrical characterization (a) cross-sectional schematic of the InSe memory device. (b) IV characteristics of the memory cell in ambient conditions